Laser Surface Cleaning

Developer: F2 Associates
Contract Number: DE-AR21-94MC30359
Crosscutting Area: N/A

Deactivation & Decommissioning FOCUS AREA

Problem:

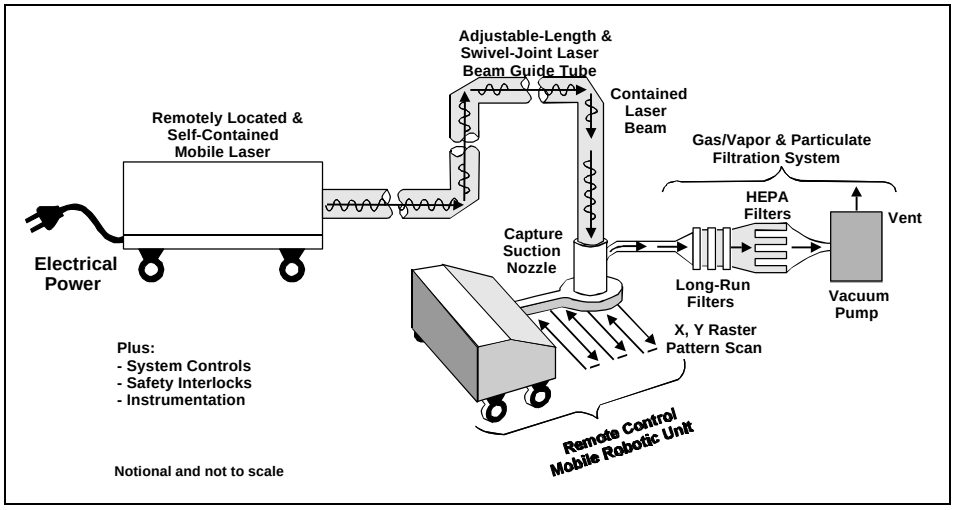
During the operating life of the Department of Energy's (DOE's) nuclear weapon production facilities, building and equipment surfaces frequently became contaminated with radiological and hazardous contaminants. To prevent contamination from becoming airborne and/or being tracked off-site, radiation workers simply painted over the contaminated areas to fix or stabilize the contaminants. Most of the earlier paint used was lead-based; more recently hydrocarbon-based and latex paints have been used. Repainting over the years has often resulted in several coats. The DOE is now in the process of deactivation & decommissioning (D&D) over 7,000 surplus buildings in the complex. For facility D&D it is desirable to remove these coatings rather than having to remove walls, floors, etc. Chemical paint strippers are messy, become contaminated, and result in an increased bulk of mixed hazardous waste. Sand, walnut-shell, water, or plastic-pellet blasting also adds to the bulk of contaminated waste. Carbon dioxide (CO_2) pellet blasting or Liquid Nitrogen (LN_2) cryrofracture does not add to the bulk, but workers must wear a supplied air respirator. None of these processes cleans out the surface pores of the substrate being de-coated. Oak Ridge National Laboratory has developed a microwave technique that does ablate the surface layer of concrete, but cannot be used for metals, nor for other substrates where substrate heating cannot be tolerated.

Solution:

F2 has developed a full-scale prototype of a robotic system that will use a pulsed-rep high power laser for floor and wall cleaning. Pulsed-repetitions CO_2 laser systems are able to effectively clean coatings from a variety of substrates including metals, composite materials, wood and concrete. Laser-based systems are well suited for the removal of many DOE complex coatings including lead-based paint, epoxy, urethane, and rust. Laser ablation is a non-contact technology. No chemicals, blasting media, or secondary waste steams are generated for collection and disposal.

Benefits:

- Non-destructive removal of coatings from floors, walls, and equipment including metals, concrete, composite materials and wood
- Reduced waste volumes (up to 75% for hydrocarbon based coatings)
- Reduced D&D time and labor intensity
- Ability to remove contaminants from surface pores



▸Integrated vacuum system for capture of contaminants resulting in reduced exposure to workers and environment

▸Amenable to robotics

Technology:

Pulsed repetition carbon dioxide laser ablation instantly vaporizes coatings with short high intensity pulses of photons or light energy. With each laser pulse, thin layers of the coatings are instantly transformed from a solid to a gas and particulate mixture, which is ejected off the substrate. The pulse duration is so short that heat is not able to diffuse inward into the substrate. As a result, the laser-cleaned surface is left cool and dry with no thermal or mechanical damage. Laser ablation systems can selectively remove individual coating layers with out affecting the integrity of the prime coat or damaging the substrate material. The laser uses the right combination of wavelength, pulse width, energy and power densities on target, pulse repetition rate, and scan rate. This yields efficient removal of the coating material from the surface and surface pores. A gas/vapor and particulate suction nozzle captures and contains the ablated material, and with other processes results in material bulk reduction. A vacuum pump then draws the mixture of entrained air and gases, vapors, and particulates resulting from ablation, through filtering stages.

Contacts:

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